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Section 2

Bi 1 HW 7

1a) Define $FC \equiv$ fold change. We thus have:

$$FC = \frac{1}{1 + \frac{R}{N_{NS}} e^{-\frac{\Delta\varepsilon_r}{k_b T}}}$$

$$\frac{R}{N_{NS}} e^{-\frac{\Delta\varepsilon_r}{k_b T}} = \frac{1}{FC} - 1$$

$$e^{-\frac{\Delta\varepsilon_r}{k_b T}} = \frac{N_{NS}}{R}\left(\frac{1}{FC} - 1\right)$$

$$\boldsymbol{\Delta\varepsilon_r = -\ln\left[\frac{N_{NS}}{R}\left(\frac{1}{FC} - 1\right)\right] k_b T}$$

1b)

O1:

$$\Delta\varepsilon_r = -\ln\left[\frac{N_{NS}}{R}\left(\frac{1}{FC} - 1\right)\right] k_b T = -\ln\left[\frac{4.6 * 10^6}{260}\left(\frac{1}{2.77 * 10^{-3}} - 1\right)\right] k_b T = \boldsymbol{-16\ k_b T}$$

O2:

$$\Delta\varepsilon_r = -\ln\left[\frac{N_{NS}}{R}\left(\frac{1}{FC} - 1\right)\right] k_b T = -\ln\left[\frac{4.6 * 10^6}{260}\left(\frac{1}{1.24 * 10^{-2}} - 1\right)\right] k_b T = \boldsymbol{-14\ k_b T}$$

O3:

$$\Delta\varepsilon_r = -\ln\left[\frac{N_{NS}}{R}\left(\frac{1}{FC} - 1\right)\right] k_b T = -\ln\left[\frac{4.6 * 10^6}{260}\left(\frac{1}{4.77 * 10^{-1}} - 1\right)\right] k_b T$$

$$= \boldsymbol{-9.9\ k_b T}$$

See Jupyter notebook for plots

2 a-e) See Jupyter notebook

3a) In general, the more that these independent determinations agree with one another, the more certain we can be in our understanding of the underlying phenomena. For example, if there are many experiments conducted to determine the exact speed of light ($2.998 * 10^8 \frac{m}{s}$), we can be almost certain that this is in fact the correct number. By the same token, if measurements of some quantity are made that disagree with one another, then our understanding of the phenomena may be flawed, and should be re-evaluated. More research/testing/experimentation should be done in order to improve the understanding of the subject.

3 b-d) See Jupyter notebook